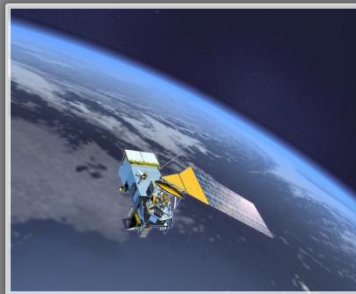
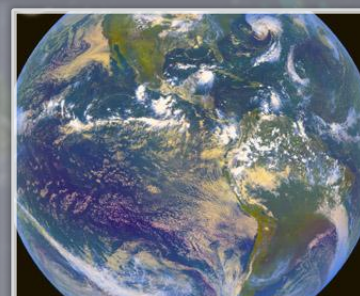


The Future of Satellite Search and Rescue

Mid-Earth Orbiting Search and Rescue (MEOSAR)



NTSB GA Search and Rescue Forum
17-18 July 2012, Washington DC



Mid-Earth Orbiting Search and Rescue (MEOSAR)

- Beginning in 2000 various studies determined that medium-earth orbiting (MEO) satellites could provide a vastly improved space-based distress alerting and locating system
- MEOSAR could address known gaps in Current Low-Earth Orbiting and Geo-Stationary SAR Systems
- NASA undertook Proof of Concept – Distress Alerting Satellite System (DASS)
- Based on POC results - Air Combat Command with GPS Directorate, NASA, NOAA, USCG, and Canadian DND are developing a operational capability on GPS III satellites– Search and Rescue / Global Portioning System (SAR/GPS)
- Supports U.S. Policy on Space-Based Positioning, Navigation & Timing Policy – SAR on GPS



DASS Proof-of-Concept

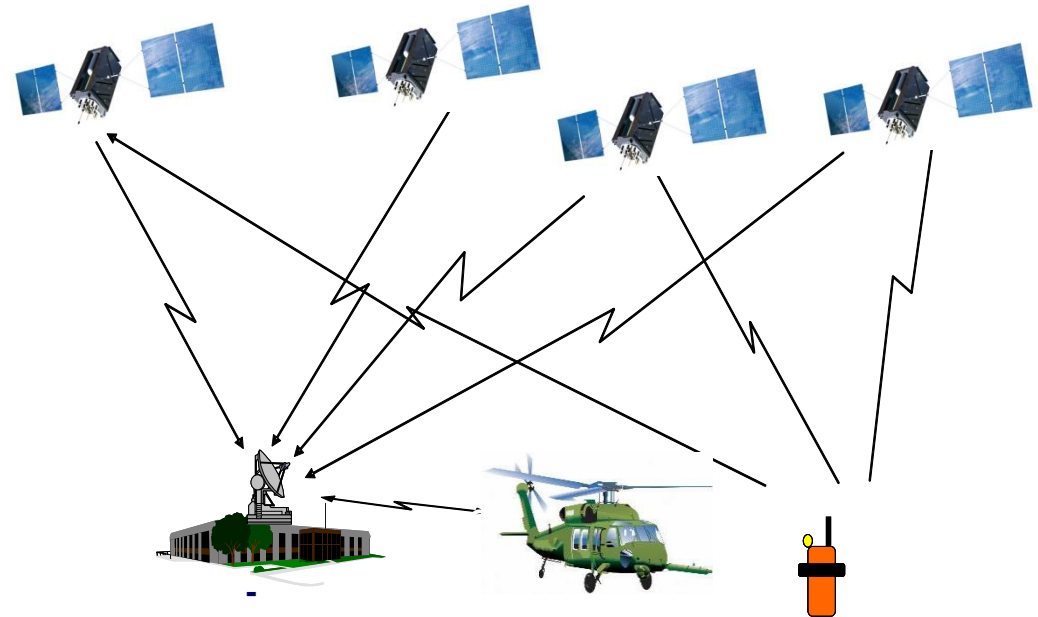
- **NASA led Proof-of-Concept included repeater on GPS IIR, IIR-M, and IIF SVs**
 - Nine on-orbit GPS Block IIR satellites carry DASS repeaters
 - 12 Additional IIR satellites + all Block IIF satellites to host repeaters
 - POC system uses existing GPS. Downlink at S-Band (Not ITU-allocated for SAR)
- **Proof-of-Concept results to date:**
 - Demonstrated ability to locate beacons to greater than current Cospas-Sarsat accuracy using two or more satellites
 - System meets/exceeds theoretical capabilities
 - Prototype ground station at NASA Goddard Space Flight Center
 - 4 antennas – capable of independently tracking 4 satellites
 - Completed in 2008
 - Successfully passed acceptance testing
 - Currently undergoing Technical refresh
 - Demonstration and Evaluation phase schedule to begin 2013



Search and Rescue / Global Positioning System (SAR/GPS)

SAR/GPS provides:

- 406 MHz “bent-pipe” repeaters on GPS - Alert data downlink freely available internationally
- Full compatibility with existing and future 406 MHz beacons
- Support for civilian and military SAR responsibilities
- Low technical risk, low cost
- SAR/GPS will be fully interoperable with similar proposed Russian (SAR/GLONASS) and European (SAR/Galileo) systems



US / Canadian Joint Effort includes repeaters on GPS III Sv#9+

- L-Band downlink – allocated for operational use



International MEOSAR Cooperation

Russia (SAR/GLONASS), USA (SAR/GPS) and ESA/EC (SAR/Galileo) working to include 406 MHz repeater instruments on future medium Earth altitude orbiting (MEO) GNSS satellite constellations

- Constellations will be fully compatible (72 Satellites)
- Coordinating with C-S on specifications and compatibility
- Global detection + location:
 - Beacon without embedded GPS - greater than Cospas-Sarsat accuracy with 3 bursts or less
 - Self-locating beacons - GPS accuracy after single beacon burst
- Return Link Capability – May allow two messages
- Demonstration and Evaluation starting in 2013 (Nine DASS test satellites , 1 SAR/GLONASS, 2 SAR/Galileo)





ME0 vs LEO Coverage





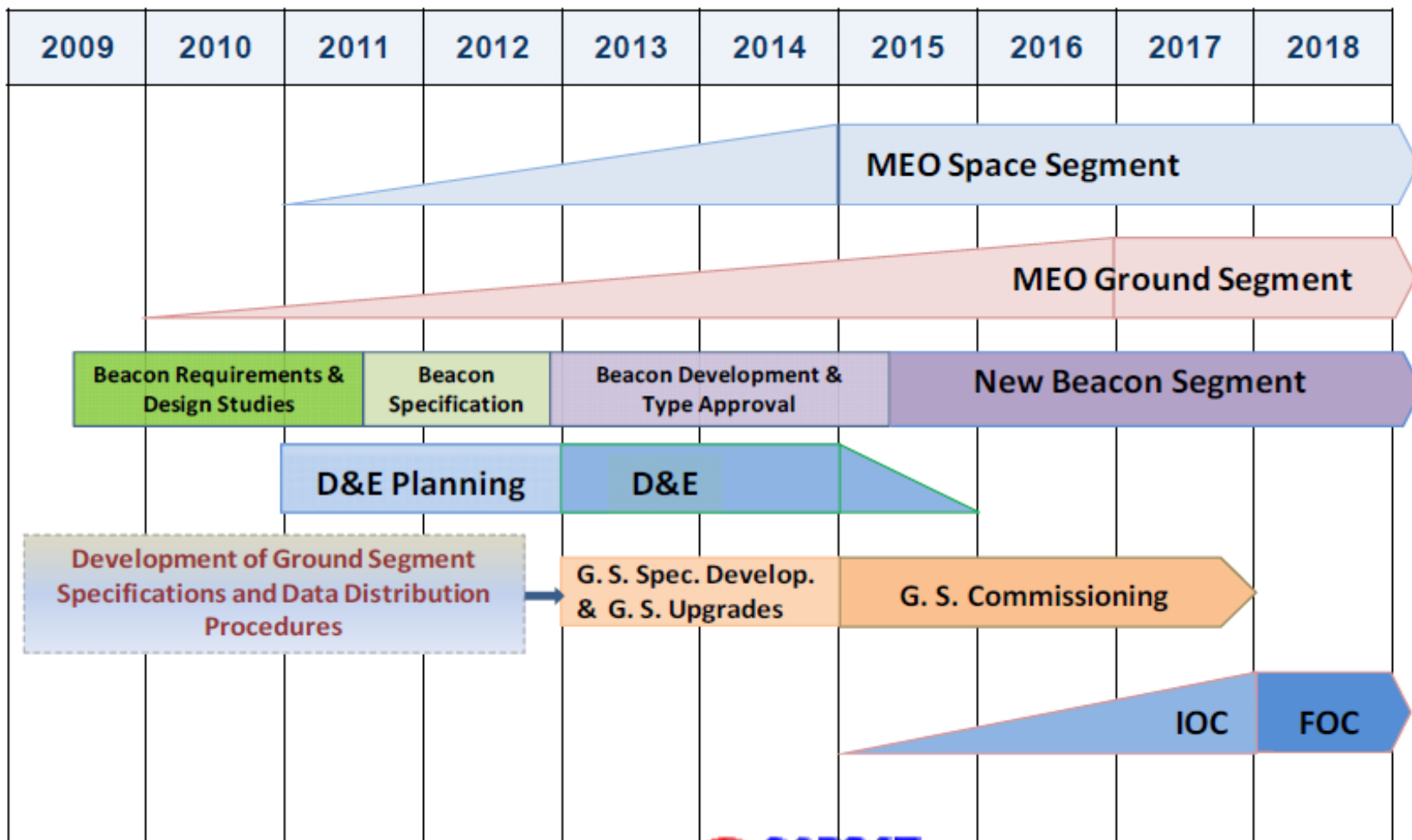
Hawaii and Florida MEOLUTs

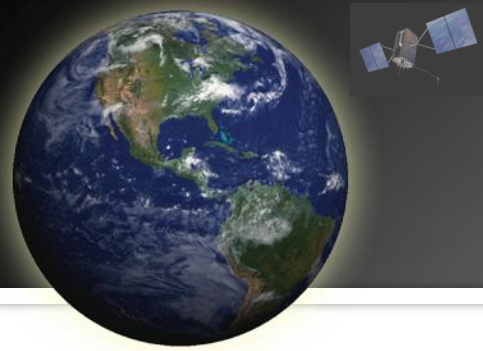


6 Channel, Stand alone



MEOSAR Timelines





Conclusions

- 1st significant modernization since system inception
- Space segment provides significant on orbit redundancy
- Long term reduction of ground segment infrastructure
- System design provides for redundant ability for location
 - TDOA/FDOA
 - GPS Encoded
- Full compatibility with existing and future 406 MHz beacons
- Continue to reduce the SAR Response chain